

# PATENT SPECIFICATION (11)

**1 370 546**

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- (21) Application No. 31566/72 (22) Filed 6 July 1972 (19)  
 (31) Convention Application No. 1 671 925 (32) Filed 6 July 1971  
 (33) Russia (SU)  
 (44) Complete Specification published 16 Oct. 1974  
 (51) International Classification A61M 1/00 25/00  
 (52) Index at acceptance  
 A5R 33C1B 33D 33G 45  
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 and LEV NIKOLAEVICH MARTYNOV



## (54) DEVICE FOR FACILITATING CARDIAC ACTION

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### ERRATUM

SPECIFICATION NO 1370546

Page 1, Heading, (72) Inventors, for VLADIMIR PANTELEI MONOVICH KHRENOV read  
 VLADIMIR PANTELEIMONOVICH KHRENOV

THE PATENT OFFICE  
 11 April 1975

R 21463/6

and by the following statement:—

The present invention relates to medical equipment and more particularly it relates to apparatus for facilitating cardiac action employed in cases of contractile incompetence of the heart during myocardial infarction, cardiogenic shock, etc.

Known in the art is an apparatus for facilitating cardiac action comprising a pump for cardiosynchronised pumping of blood and a short catheter introduced into the left ventricle of the heart through a section in the wall of said ventricle and communicating with the suction side of the pump through a pipe. The pump outlet communicates with the aortic arch through another catheter inserted into the aorta through a cut in its wall. The pump sucks blood from the left ventricle through the first short catheter and delivers it into the aortic arch.

A disadvantage of the known device for facilitating cardiac action lies in that its employment involves a heavy cavitory operation, viz., exposure of the heart, dissection of the upper part of the left ventricle, introducing and fastening in it a short catheter leading from the suction side of the pump, cutting the wall of the aorta and suturing in a short catheter communicating with the delivery side of the pump.

The above-mentioned operation renders

synchronised pumping of blood and a catheter communicating with the pump and having a proximal end part for introduction into the left ventricle of the heart through the aortic arch, said catheter end part being provided with an inlet valve for enabling the pump to draw in a portion of blood from said ventricle and said catheter being provided with an outlet valve for enabling the pump to force said portion of blood into the aortic arch, said outlet valve being located at a distance from the proximal end part of the catheter which would enable said outlet valve to be located in the aortic arch when the proximal end of the catheter is fully inserted into the left ventricle.

The apparatus according to the invention can be used without a heavy cavitory operation (section through the wall of the upper part of the left ventricle and dissection of the wall of the aortic arch), it can be readily and speedily used in case of grave myocardial infarction, cardiogenic shock and acute heart weakness and can be employed in a clinic, a hospital, in special motor ambulances or as a domiciliary treatment.

An embodiment of the invention will now be described in detail by way of example with reference to the drawings, in which:

Fig. 1 is a schematic diagram of apparatus in accordance with the invention for

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(54) DEVICE FOR FACILITATING CARDIAC ACTION

(71) We, VSESOJUZNY NAUCHNO-  
 ISSLEDOVATELSKY I ISPYTATELNY INSTITUT  
 MEDITSINSKOI TEKNIKI MINISTERSTVA  
 ZDRAVOOKHRANENIA SSSR, an enterprise  
 5 organised and existing under the laws of  
 the Union of Soviet Socialist Republics  
 (USSR) of 3 ulitsa Kasatkina, Moscow,  
 USSR, do hereby declare the invention, for  
 which we pray that a patent may be granted  
 10 to us, and the method by which it is to be  
 performed, to be particularly described in  
 and by the following statement:—

The present invention relates to medical  
 equipment and more particularly it relates  
 15 to apparatus for facilitating cardiac action  
 employed in cases of contractile incompet-  
 ence of the heart during myocardial infarction,  
 cardiogenic shock, etc.

Known in the art is an apparatus for  
 20 facilitating cardiac action comprising a  
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 blood and a short catheter introduced into  
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 25 section in the wall of said ventricle and  
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A disadvantage of the known device for  
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 tricle, introducing and fastening in it a  
 short catheter leading from the suction side  
 40 of the pump, cutting the wall of the aorta  
 and suturing in a short catheter communi-  
 cating with the delivery side of the pump.

The above-mentioned operation renders

said apparatus practically useless in case  
 of heavy myocardial infarction and cardio- 45  
 genic shock, i.e. just when aid of this kind  
 is justified and indispensable.

An object of the present invention is to  
 obviate or mitigate the disadvantages out- 50  
 lined above.

According to the present invention there  
 is provided apparatus for facilitating cardiac  
 action, comprising a pump for cardio-  
 synchronised pumping of blood and a  
 catheter communicating with the pump and 55  
 having a proximal end part for introduction  
 into the left ventricle of the heart through  
 the aortic arch, said catheter end part be-  
 ing provided with an inlet valve for en-  
 60 abling the pump to draw in a portion of  
 blood from said ventricle and said catheter  
 being provided with an outlet valve for en-  
 abling the pump to force said portion of  
 blood into the aortic arch, said outlet valve  
 65 being located at a distance from the prox-  
 imal end part of the catheter which would  
 enable said outlet valve to be located in  
 the aortic arch when the proximal end of  
 the catheter is fully inserted into the left  
 70 ventricle.

The apparatus according to the invention  
 can be used without a heavy cavitory opera-  
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 ployed in a clinic, a hospital, in special  
 80 motor ambulances or as a domiciliary treat-  
 ment.

An embodiment of the invention will now  
 be described in detail by way of example  
 with reference to the drawings, in which:

Fig. 1 is a schematic diagram of appa- 85  
 ratus in accordance with the invention for

SEE ERRATA SLIP ATTACHED

facilitating cardiac action and shows a catheter of the apparatus implunged into the left ventricle of the heart;

Fig. 2 is an enlarged longitudinal section of the inner end part of the catheter shown in Fig. 1;

Fig. 3 is a similar view to that shown in Fig. 2 but showing blood being sucked into the catheter;

Fig. 4 is a similar view to that shown in Figs. 2 and 3 but showing blood being forced into the aortic arch.

Apparatus for facilitating cardiac action comprises a pump 1 (Fig. 1) e.g. a diaphragm pump, for cardiosynchronised pumping of blood, and a catheter 2 communicating with the pump, the catheter having a proximal end part for introduction into the left ventricle of the heart through the aortic arch (Fig. 1). The proximal end part is provided with an inlet valve 3 for enabling the pump 1 to draw in a portion of blood from the left ventricle 4 *via* the catheter during each intake stroke of the pump and an outlet valve 5 is provided on the catheter at a spaced apart location from the proximal end so that the outlet valve is located in the aortic arch when the proximal end of the catheter is fully inserted into the left ventricle, whereby in use the pump is able to force a portion of blood into the arch of the aorta 6 *via* the catheter during each exhaust stroke of the pump. The inlet valve 3 is made in the form of slotted openings 7 (Fig. 2) closed with elastic tongues 8 located on the inside surface of the catheter 2 while the outlet valve 5 consists of slotted openings 9 closed by elastic tongues 10 on the external side of the catheter 2.

The illustrated apparatus for facilitating cardiac action is used as follows.

To implunge the catheter into the heart, one of the peripheral arteries, e.g. the left subclavian artery is exposed, its wall is dissected and the catheter 2 is inserted through the cut into the arch of the aorta 6 (Fig. 1) towards the aortic valves of the left ventricle 4. The proximal end of the catheter having the inlet valve 3 of the catheter 2 passes through the valve hole of the left ventricle 4 and enters the inside space of said ventricle. The inlet valve 3 is positioned in said space in such a manner as to locate the outlet valve 5 of the catheter 2 in the ascending part of the arch of the aorta 6, in the space above the aorta valves. The position of the catheter 2 can be controlled with the aid of a television X-ray apparatus.

The illustrated apparatus operates as follows.

After starting the pump 1, a vacuum is built up in its chamber at the end of diastole and during the systole and the blood is drawn from the left ventricle 4 through the slotted openings 7 (Fig. 3) of the inlet valve 3 into the catheter 2 and thence into the chamber of the pump 1 (Fig. 1). Meanwhile the slotted openings 9 (Fig. 3) of the outlet valve 5 are closed by the elastic tongues 10 (the direction of blood circulation is shown by arrows).

At the end of the systole an overpressure is built up in the chamber of the pump 1 (Fig. 1) and the blood is delivered from said chamber through the catheter 2 and slotted openings 9 (as shown by arrows in Fig. 4) into the arch of the aorta 6 (Fig. 1). Meanwhile the slotted openings 7 (Fig. 4) are closed.

An advantage of the above described apparatus is that it reduces and simplifies surgical intervention in assisting an affected heart, in that it can be easily and speedily connected to a heart in cases of heavy myocardial infarction.

#### WHAT WE CLAIM IS:—

1. Apparatus for facilitating cardiac action, comprising a pump for cardiosynchronised pumping of blood and a catheter communicating with the pump and having a proximal end part for introduction into the left ventricle of the heart through the aortic arch, said catheter end part being provided with an inlet valve for enabling the pump to draw in a portion of blood from said ventricle and said catheter being provided with an outlet valve for enabling the pump to force said portion of blood into the aortic arch, said outlet valve being located at a distance from the proximal end part of the catheter which would enable said outlet valve to be located in the aortic arch when the proximal end of the catheter is fully inserted into the left ventricle.

2. Apparatus for facilitating cardiac action, substantially as hereinbefore described with reference to the accompanying drawings.

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## COMPLETE SPECIFICATION

This drawing is a reproduction of  
the Original on a reduced scale

Sheet 1

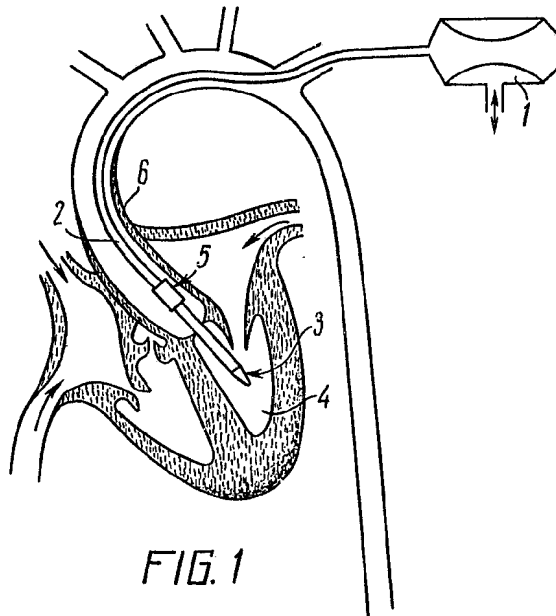


FIG. 1

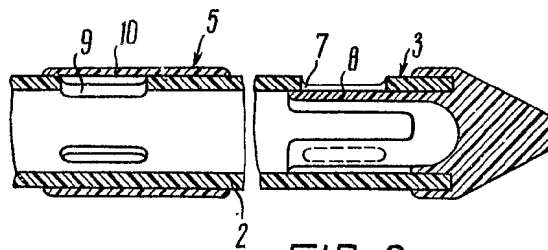


FIG. 2

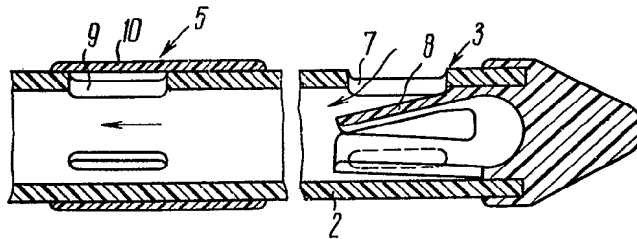


FIG. 3

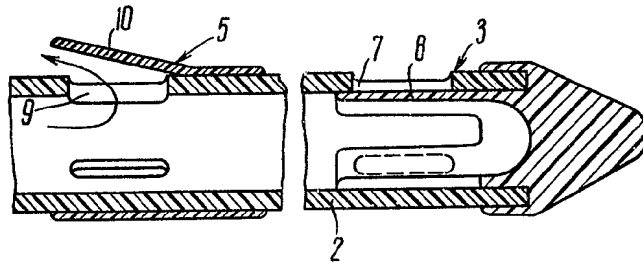


FIG. 4